elements with very nearly the same weight might possess very similar properties. This would allow the truth of the following table, in which only three assumptions are made.

(1) It is possible that two elements of nearly the same atomic weight may occupy the same place in the table.

(2) The emission of an α-particle is accompanied by the production of an element which occupies the adjacent space of lower atomic weight.

(3) The emission of a β-particle, or a rayless change, may or may not be accompanied by a remove to a space of lower atomic weight.

In the table the elements which emit α-particles are printed in thick type, the other radio-active elements in italics.

								H 1
He 4	Li 7	Be 9	B 11	C 12	N 14	O 16	Fl 19	
Ne 20	Na 23	Mg 24	Al 27	Si 28	P 31	S 32	Cl 35·5	
Ar 40	*K* 39	Ca 40	Sc 44	Ti 48	V 51	Cr 52	Mn 55	Fe 56 Co 59 Ni 59
	Cu 64	Zn 65	Ga 70	Ge 72	As 75	Se 79	Br 80	
Kr 83	*Rb* 85·5	Sr 88	Y 89	Zr 90	Cb 93·5	Mo 96	Np? 100?	Ru 102 Rh 103 Pd 107
	Ag 108	Cd 112	Am 115	Sn 119	Sb 120	Te 127·5	I 127	
X 131	Cs 133	Ba 137	La 139	Ce, &c. 140–178	Ta 181	W 184		Os 191 Ir 193 Pt 195
	Au 197	Hg 200	Tl 204	Pb 207	Bi 208 ← RaF ← E_2 ← E_1 ← *D*	? ← *Act C* ← Th C ← Ra C ← *RaB*	← Act B ← *A* ← Th B ← *A* ← RaA	
← Act Em ← Th Em ← Ra Em	← ActX′ ← ThX	← Radio-Act ← Radio-Th ← Ra 226·5	*Act* ← *Mesoth.*2 ← *I* ← Ionium ← *UrX*	Th 232·5	← Radio-Ur?	Ur 238·5		

In considering this table, if we assume that Rutherford and Soddy's theory, that the loss of an α-particle is accompanied by a corresponding decrease of 4 in the atomic weight, is correct, it seems certainly necessary to confine radium and radio-thorium to the same space in the table. They are both members of the barium series. The atomic weight of radium is 226·5, while that of radio-thorium must be (232·5−4)=228·5. Similarly the thorium and radium emanations resemble each other so closely that it is legitimate to suppose that they occupy the same space. They condense at almost the same temperature, while their rates of diffusion into other gases are very nearly the same. If one case is admitted, the whole is rendered probable. The evidence with the actinium series is not so positive, but the present arrangement satisfies the known facts.

It may be pointed out that there are three α-emitting elements between radium emanation and lead, and only three spaces in the table, and two α-emitting elements between thorium emanation and bismuth, with two spaces corresponding; lead and bismuth were suggested by Rutherford and Boltwood as the respective end-products of these series. Again, it may be emphasised that the anomalous existence of the group of rare earth metals, giving a difference of more than 40 in the atomic weight of the elements which precede and follow them, explains the change of the difference between two elements of a vertical series from about 46 to nearly twice that figure, so that no element of the argon series is to be expected between xenon and one with a weight about 220. *Except in the two spaces in the vertical series below manganese*, and possibly in the rare earth series, *there is no vacant space in the periodic table between hydrogen and uranium*. In this connection it is interesting to recall the suggestion of R. W. Wood (Astrophys. Journ., 1908, vol. xxviii., p. 75), that the green line in the spectrum of the sun's corona is the fluorescent line of some common element, and that the supposed element "coronium" of weight less than hydrogen does not exist.

It is possible that other β-emitting or rayless elements may be discovered. How far these are really *elements* depends, of course, on the *specific* physical and chemical properties they possess. These are often none too well defined. The mechanism of a rayless change, or one accompanied by the emission of a β-particle, may be compared with a change of frequent occurrence with organic compounds, the formation of one desmotropic substance from another under the influence of heat.

It must be remembered that should the conclusions be correct which are drawn from the recent work of Ramsay and Gray on the boiling point and critical constants of radium emanation, and should the atomic weight of 176 be confirmed, not only are the above arguments invalidated, but the whole theory of disintegration put forward by Rutherford and Soddy will require modification.

University College, London. A. T. CAMERON.

Radio-activity and the Rocks.

IN the course of some observations which I have recently made with regard to the pleochroic halos sometimes seen round inclusions in various rock-forming minerals, certain points have suggested themselves as possibly of considerable significance. It may be premised that Prof. Joly's suggestion that the halos are due to the α rays emitted by radium appears fully borne out by their remarkable constancy in size and by the fact that they are invariably connected with minerals independently known to be strongly radio-active, that is, comparatively speaking. The only qualification that need be made respecting this view is with regard to the possibility of radio-active substances other than radium producing the observed effects.

So far as my experience goes, the following minerals are capable of producing halos when enclosed in suitable substances like biotite, cordierite, hornblende, tourmaline, &c., zircon, orthite (allanite), epidote, sphene, and apatite. All these are silicates, except apatite, which is a phosphate. The last three are lime compounds, which does not, however, seem to be of any particular import. Zircon contains zirconium, orthite cerium and its allies, and sphene titanium, and it may be noted that orthite always contains thorium in some quantity, while both zircon and sphene may be expected, from a mineralogical point of view, to contain that element as an impurity. Epidote, being isomorphous with orthite, and frequently intergrown with it in rocks, the presence of some traces of thorium may also be generally presumed. As regards apatite, it is obviously significant that the other two phosphates which occasionally occur as rock-formers, namely, monazite and xenotime, always contain thorium in considerable amount; indeed, monazite owes its commercial value to the constant presence of that element. It would appear, therefore, as if the radio-activity of all the minerals cited might, unless other considerations are opposed to the idea, be fairly attributed to the presence of thorium.

There is, however, another feature of these minerals which may be of significance. It will be noticed that one or other of them contains all the elements grouped under

carbon in series four of the periodic table, namely, titanium, zirconium, cerium, and thorium. Indeed, "carbonaceous matter" is itself recorded by Prof. Rosenbusch ("Rock-making Minerals," p. 197) as giving rise to pleochroic halos in andalusite. Of course, this might imply nothing more than that chemical similarity leads to similar impurities (*e.g.* thorium), to which the radioactivity may be due. It is not easy to see how such an explanation would fit the case of carbon, but otherwise it would readily account for the fact that halos are not always seen round the minerals mentioned above, and that they may occur round some crystals and yet not round others in the same rock. They are most common, indeed practically constant, round zircon and orthite, but are confined to a few occurrences of the abundant minerals sphene, apatite, and epidote.

Another point which seems to deserve emphasis is the fact that, from a geological point of view, the radioactivity of thorium must surely be a far more potent factor than that of uranium and its derivatives. For there is no mineral which occurs in ordinary rocks which appears to contain uranium in quantities appreciable by chemical methods, whereas, as will be inferred from what has been already said, thorium is of extremely wide distribution.

F. P. MENNELL.

Bulawayo, Rhodesia, October 18.

Magnetic Storms.

IN his letter (NATURE, November 11) Dr. Simpson raises an argument as to the absence of corresponding changes in the electrical potential gradient during magnetic storms which, if admitted, would, I imagine, prove a serious difficulty in the "electron stream" theory of magnetic disturbances. On the assumption that the arriving stream induces an opposite charge which resides at the earth's surface, we can agree with Dr. Simpson's calculation, except that, since there are two current sheets of opposite sign, the potential gradient ought to be half what he finds.

It seems to me most unlikely that the induced charge resides at the earth's surface. The atmosphere is slightly conducting, and it is throughout it that the induced charge distributes itself. It is well known that a very slightly conducting shell will with great rapidity act as a perfect electrostatic screen, but, on the contrary, fails to screen magnetic effects. In his paper (Phil. Trans., A, 1908) on terrestrial magnetism, Dr. Schuster points out that the normal conductivity of air at the earth's surface is about 10^{-24}, while at a height such that the pressure is 1 dyne per sq. cm. the conductivity would be about 10^{-18}. For such a conductivity the time constant of decay would be about 10^{-4} of a second, or, in other words, practically complete electrostatic screening would be established in about one-thousandth part of a second, and correspondingly the slight initial magnetic screening would then cease. We have thus a simple explanation of the absence of direct electrostatic effects at the surface of the earth due to "electron streams" several hundred kilometres above the earth. The earth currents which do accompany magnetic storms are thus referred, not to electrostatic induction, but to change of magnetic induction at the earth's surface.

GEORGE W. WALKER.

Eskdalemuir Magnetic Observatory, November 12.

The Photometric Measurement of the Obliquity Factor of Diffraction.

IN vol. lxxviii. of NATURE (May 21, 1908, p. 55) was published a note on "Secondary Waves of Light," in which I described the diffraction effects produced by an obliquely held rectangular aperture or reflecting surface, and pointed out that the observed distribution of illumination in the pattern was not in accordance with that deduced in the ordinary way. I indicated an explanation of the discrepancy, that it was due to the variation of the obliquity factor of diffraction within the limits of the pattern.

The interest of the observations lay in the fact that such an effect had never been noticed before, and that the observations enabled us actually to trace the variation of the amplitude of vibration from point to point on Huygens's secondary waves. A full description of the effect and a mathematical investigation were published in the *Philosophical Magazine* for January.

The effect observed was that the intensities of illumination in corresponding bands on opposite sides of the central band in the unsymmetrical pattern were unequal. A photometric investigation of this difference in illumination has been carried out. The method was to use revolving sectors to reduce the illumination in one of the two bands to be compared, so as to make them both of equal brightness. The following table illustrates the comparisons made:—

No. of expt.	Ratio of illumination according to ordinary theory	Ratio of illumination actually determined	Ratio of illumination calculated from obliquity
1	1·00	1·66	1·61
2	1·00	1·81	1·98
3	1·00	2·66	2·43
4	1·00	3·25	3·27

The obliquity law demonstrated by these measurements is that, in the hemispherical wavelets emitted by each element of a transmitting aperture or reflecting surface upon which waves are incident at any angle, the amplitude of the light vector is, at any point in the plane of incidence, proportional to the cosine of the angle made by the line joining that point and the element, with the normal to the plane of the element.

C. V. RAMAN.

Post-Box 59, Rangoon.

Mendelian Heredity: A Correction.

I SHOULD be glad of an opportunity of correcting the following errors in my book "Mendel's Principles of Heredity":—

On p. 35, Davenport's result regarding rumplessness in fowls is accidentally inverted. The character, according to him, is recessive, not dominant as stated by me. I have to thank Prof. Arnold Lang for this correction.

The other, and more serious, error is in the description of Fig. 34 of the second impression of the book (p. 231). In giving a tentative scheme for the descent of colour-blindness, I there stated that a male homozygous for colour-blindness could be produced by the mating of two colour-blind parents; but if the scheme is right, it evidently follows that such a male cannot be formed even from that mating.

W. BATESON.

November 12.

The Functions of the Martian Canals.

WITH reference to the recent paper by Dr. Pocklington before the Royal Society, on the functions of the Martian canals, a notice of which appeared in NATURE of November 11 (p. 58), I should like to suggest that these canals may perhaps be used for power-storage purposes. In Mars, possibly, there are seasons of winds or monsoons during which the upper reaches of the canals would be pumped full by innumerable windmills, and the power thus stored utilised during calm seasons, and transmitted electrically for lighting, heating, and general power purposes. For a population which had exhausted all its mineral fuel, which possessed no extensive ocean, and whose soil and climate were unsuitable for the growth of fuel, this would indeed appear to be the only means of obtaining heat and power. The same canals could serve the triple purposes of communication, power, and irrigation.

H. F. HUNT.

7 Officers' Row, Pembroke Dock, Wales,
November 13.

GRAVITY SURVEY.[1]

THE two publications described below afford a remarkable example of the value of an International Bureau worked in the right spirit and used in the right way. The sumptuous institute upon the Telegraphenberg at Potsdam is the home of the

1 "Survey of India: Professional Paper, No. 10. The Pendulum Operations in India, 1903–7." By Major G. P. Lenox-Conyngham, R.E.; with an appendix by A. Strahan, F.R.S. Pp. ix+196. (Dehra Dun, 1908.)
"Deutsche Südpolar Expedition, 1901–3." Band i., Geographie; Heft iii., Die Schwerkraftsbestimmungen der Deutschen Südpolar Expedition. By E. von Drygalski und L. Haasemann. Pp. 285–363. (Berlin: Georg Reimer, 1909.) Price 12.80 marks.